Care Homes Analysis

Background

Some 400,000 older people live in care homes in the UK.[1], the majority of whom are over 80, and female. People living in care homes are at high risk of C-19 mortality, due both to their age and living circumstances. The household structure and semi-closed (yet interconnected) nature of the care home sector make homes especially vulnerable to high attack rates during infectious disease outbreaks[2]. Risk is however not uniform and is affected by household size and composition, (e.g., small care homes can have higher incidence of influenza outbreaks than larger ones)[3].

Men and women working in social care, including care workers and home carers, are also at high risk of C-19 infection, due to work related, socio-economic and other factors. In London, 67% of adult social care staff are BAME, and live in overcrowded/intergenerational housing. Recent ONS data suggest significantly raised rates of death involving COVID-19 than the general population, or health-workers (with rates of 23.4 deaths per 100,000 males (45 deaths) and 9.6 deaths per 100,000 females (86 deaths)).

Testing in homes is being scaled up across the UK. The testing arrangements are complex, as testing may occur as a result of investigation of a symptomatic case, as part of the pathway for discharge from a hospital setting to a care home, or as part of a programme to roll out testing for all care home and residents and staff. Broadly, the current elements of the testing programme are as follows:

1. Following a resident with COVID-19 symptoms PHE will arrange testing for all residents in the care home.
2. Any symptomatic staff in a care home will be tested
3. All care home staff and residents will be tested over a rolling 4-week programme
4. Prioritisation will be at local level, taking account of homes at greater risk of outbreaks by virtue of their size, whether or not they have had an outbreak to date, and staff and/or resident profile.
5. All those being admitted from another healthcare facility will **be tested prior to** discharge

In Scotland, the guidance is for **two negative tests** in order to leave hospital and return to a care home. Testing outbreaks as advised by local Health Protection teams

[1] Age UK. *Later life in the United Kingdom 2019* Factsheet. https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/later_life_uk_factsheet.pdf

[2] Cassell, Middleton, Nalabanda, et al. (2018) Scabies outbreaks in ten care homes for elderly people: a prospective study of clinical features, epidemiology, and treatment outcomes. Lancet Infect Dis 18;8. Kinyanjui, Middleton, Guteel, Cassell, Ross, House (2018) Scabies in Residential Care Homes: Modelling, inference and interventions for well-connected population sub-units. PLoS Comp Biol 14:3.

[3] Shah, Harries, Cleary, McGiverne, Ghebrehewet. (2019) Use of prophylactic antivirals and care home characteristics associated with influenza in care homes with confirmed outbreaks. Public Health 177; 48-56. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3284301/pdf/JRSM-11-0249.pdf https://www.cambridge.org/core/journals/epidemiology-and-infection/article/an-analysis-of-influenza-outbreaks-in-institutions-and-enclosed-societies/67E68EF3DCFCC268199DDE481A7F3B63

Questions addressed in this paper

In support of the expanded testing and care for care homes, and implementation of complementary prevention activities, this paper provides an assessment of current evidence on the types of homes that are most vulnerable to C-19 outbreaks, optimal approaches to testing, and the potential value of other protection approaches.

Specifically, the paper considers evidence on the following:

1) What does the current evidence tell us about the main routes of transmission mechanisms between care homes and within care homes (risk to the vulnerable population), and what forms of care home are at greatest risk? Are there key differences by geography, including across the DAs?
2) What are current and projected trends in transmission in Care Homes? Do recent declines in cases suggest that the situation is under control?
3) What approach to swabbing and testing is likely to be most effective in reducing rates of infection? Is there evidence to support:
    a. Testing all residents, irrespective of whether symptomatic or not?
    b. Testing all staff working in homes (eg care workers, cooks, receptionists)?
    c. How to prioritise testing – including between homes, those who do and do not report infection, and the frequency of testing of residents / care home staff?
    d. Is there evidence to support the value of weekly testing?
4) What impact may different approaches to reducing risk, including:
    a. Non-rotation of care workers (stopping care workers operating in multiple homes)
    b. Cohorting of residents
    c. Handwashing, IPV, regular surface cleaning and monthly deep cleaning

Conclusions

Response to Q1: **What does the current evidence tell us about the main routes of transmission mechanisms between care homes and within care homes (risk to the vulnerable population), and what forms of care home are at greatest risk? Are there key differences by geography, including across the DAs?**

- Figure 10 below shows the current spatial distribution of care homes that have reported an outbreak to date. Some local authorities (i.e. Liverpool, Oxfordshire) have suffered higher numbers of outbreaks than might have been expected given the number of care homes locally. The absolute number of outbreaks is highest in Birmingham (104 outbreaks), Leeds (83) and Sheffield (75).

- Nursing home (Figure 9) have consistently higher rates of reporting outbreaks than care homes. Both residential and nursing homes show an increase as home size increases.
- Scotland, Northern Ireland and Wales show similar patterns to England, with larger care homes suffering higher infection rates.
- The means of introduction of new disease cases to care homes is multiple: linked to the connection between care homes and hospitals, and the connection between staff and community (medium confidence). We cannot say which is more influential at this stage.
- We expect (high confidence low evidence) that hospital discharges and visits may have been an important source of introduction of C-19 infection to care homes. We expect

that the routine testing of patients leaving hospital will help address this, although there may be a continued risk of infection from of false negatives returning to homes.

- The Second Generation Surveillance System (SGSS) data on positive and negative swab results shows that within care home transmission is highly likely, though many of these outbreaks are censored so final outbreak size hard to quantify. Initial limits to testing access is likely to mean that the number of positive tests is a major underestimate of cases to date. Evidence suggests that in some instances, outbreaks slowly percolate across homes. In other cases outbreaks are more explosive.

DATA GAPS:

- Further modelling could help quantify secondary attack rates and estimate final attack rates. (Annex 1 & 2). The reproduction number in homes is a function of number of contacts and probability of transmission given contact. As contact rates are highly variable and dependent on care needs/role of staff in care home, we would expect the reproduction rate to also be heterogeneous.

- Better linkage between hospital discharge notes and care home readmission would help to assess more accurately the connectedness/transmission from hospital and care home setting and visa verse. The WG will explore options moving forward.

Response to Q2: **What are current and projected trends in transmission in Care Homes? Do recent declines in cases suggest that the situation is under control?**

We can say with strong confidence that:

- the number of all cause deaths reported to CQC has dropped from a peak in mid-April. These declines have been seen in both nursing and care homes (see Figure 2). All cause deaths in domiciliary care reported to CQC have plateaued over this period (though only about 10% of all care home deaths).

- There is no evidence of confirmed COVID19 deaths decreasing. All COVID flagged deaths dropped in late April, but this is driven by a drop in suspected cases. Furthermore, the drop in COVID19 flagged deaths in recent days may be a surveillance effect.

- The number of new outbreaks reported to PHE has dropped from around 150 per day to 100 per day in England, with some regional differences.

- The SGSS data shows that outbreaks are likely to be ongoing, with gaps in the time between the positive swabbing results being due to ongoing transmission, false negative results, or the new introduction of disease to care home (Figure 5).

- The decline in outbreaks reported and newly notified deaths is a positive sign. However, given asymptomatic infection and relatively recent increases in testing capacity, numbers are highly variable. We can say with moderate confidence that it is highly probable that we will see both new and ongoing outbreaks moving forward.

Response to Q3: **What approach to swabbing and testing is likely to be most effective in reducing rates of infection? Is there evidence to support:**

- ***Testing all residents, irrespective of whether symptomatic or not?***
- ***Testing all staff working in homes (e.g., care workers, cooks, receptionists)?***

- ***How to prioritise testing – including between homes, those who do and do not report infection, and the frequency of testing of residents / care home staff?***
- ***Is there evidence to support the value of weekly testing?***

The large scale implementation of testing in care homes is central to preventing and managing outbreaks. Testing can only support reduction of infection rates if coupled with actions to reduce contacts with positive cases and infection control more generally. The current testing strategy focuses initially on homes that have reported or suspected cases, with largest homes being prioritised.

We can say with medium confidence that:

- Given the importance of trying to stop the spread of infection into homes, and the risk of asymptomatic infection and transmission, testing should include homes that do not report cases, as well as those with suspected or confirmed cases. If no testing has been done, the priority should be given to larger care homes that are at higher indicators of risk, as detailed above. Follow-up action should then prioritise preventing infection being imported into these homes. This approach has been adopted in some settings, such as Liverpool.

- Within homes, there is a strong scientific rationale to test all residents, irrespective of whether symptomatic or not, given strong evidence of asymptomatic transmission in care homes.

- For the same reasons, there is a strong scientific rationale to test all staff working in homes (e.g., care workers, cooks, receptionists). As well as ensuring that these staff isolate, it will be important to ensure that the results can be linked to ALL of the care homes they have worked in, and follow-up testing in other homes conducted.

- Homes with positive returns should be re-tested on weekly basis to check of ongoing transmission. Similarly, homes with negative results *should be re-tested each week to* check for importation of disease or false negative results from previous testing rounds every week. Repeating testing of individuals with negative results would assist with identifying false negatives results.

- **DATA GAPS**: Regardless of testing strategy, the collection of data on individuals is critical to understand the transmission patterns and monitor efficacy of future interventions, specifically recording whether individuals are staff (by type of staff) and residents (including whether residents had joined/re-joined home recently) within the care home.

Response to Q4: **What impact may different approaches to reducing risk, including:**

a. Non-rotation of care workers (stopping care workers operating in multiple homes)
b. Cohorting of residents
c. Handwashing, IPC, regular surface cleaning and monthly deep cleaning

Non-rotation of care workers

- We can say with medium confidence that reducing the interaction of a people in a care home with the wider community will reduce risk of C-19 importation, which is key to effective shielding. This may involve reducing contact between staff and community (including stopping work in multiple homes) and testing new residents coming into care home, with isolation for people testing positive for COVID19.

- Despite the potential reduction in risk of the non-rotation of care workers, there may be multiple operational challenges to achieving this – with economic pressures on care workers and homes (including the widespread use of agency workers to address shortages of staff) potentially making implementation challenging. For frail populations, there will be need for caution, to ensure that there is not an increased risk of death as a result of inadequate staffing.

Cohorting of residents

- Cohorting of residents to receive care from a small number of carers has the potential to reduce transmission through limiting contacts. If this can be implemented easily, it has the potential to reduce risk.

- However, this may introduce new elements of risk, if residents need to be moved, and will require careful consideration. It has long been accepted that moving residents of care homes is associated with increased mortality, with up to 25% excess 6 month mortality reported in residents who moved compared to control, although excess mortality can be minimised with well-planned and organised moves.

- Decisions will need to be guided by evidence on what elements of a move produce the greatest stress, which individuals are most likely to be vulnerable and which procedures minimise stress and improve outcomes.

Handwashing, infection control, surface cleaning and deep cleaning

- There appears to be very little data on the role of the physical environment on infection risk within care homes, but the small number of studies suggest that it is important.

- Curran 4 flags that knowledge about the infection, appropriate cleaning solutions and frequency of cleaning among care workers affects risk. He recommends that common areas should be a greater focus for IPC, as most guidelines focus on protocols within resident's rooms.

- There is good evidence from C Diff and MRSA infection control in hospitals that deep cleaning is important, but that spaces where there are infectious people re-contaminate quickly. For C-19, however, deep cleaning may not be a suitable strategy. Deep cleaning works for those pathogens that can survive for very long periods in the environment (like C Diff) that sit for weeks and then remerge to cause a new outbreak). For this reason, there is no strong evidence to support deep cleaning. Instead the evidence supports the importance of regular cleaning, including of communal spaces.

- Important actions recommended by the EMG include: review current IPC guidelines in care homes against current knowledge of transmission mechanisms and mitigation actions, and update to address any gaps. EMG environmental transmission papers, new paper on hospitals has been shared to support this, EMG are currently looking at evidence for practical mitigations and will share ASAP.

- Although care homes were not considered, the outputs from the Nosocomial transmission working group showing between staff transmission is likely to have

[4] Curran, E. T. (2017) 'Infection outbreaks in care homes: prevention and management.', *Nursing Times*, p. 77. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=127120230&site=ehost-live.

relevance in the care setting too – for example, with the risk of infection being among care workers during breaks, or in their living arrangements.

Future research priorities

- Sero-surveys of residents – Older groups, and key workers, including care home staff, are at greatest risk of COVID-19. Evidence on the levels of antibody response among these groups is important, given their vulnerability. The timing and practicalities of such a survey should be considered carefully and draw upon the expertise of research groups with a history of working with vulnerable populations. Given the potential for declining incidence, these studies will need to be conducted rapidly.

Environmental surveillance studies:

- At a national level/within a survey project include questions on the physical environment (e.g., age of building, area/resident, typology/layout, ventilation, connectivity to other buildings) alongside data on cleaning/IPC and staff movement together with case data. Could allow identification of any risk factors.
- Add physical environmental data collection into environmental (air and surface) sampling studies – EMG are planning to put together a funding application to do this alongside a PHE study that is expected to undertake sampling in care homes in the South West.
- Include physical environment parameters as part of the post outbreak analysis for care home outbreaks – talking to PHE we think there may be some data to enable this and will include within funding application.
- **Modelling analyses** – Previous work that went to SPIM from University of Manchester (refs 23 and 34) and London School of Hygiene and Tropical Medicine (Annex 1) has shown the potential for modelling to support policy choices. For these to be more effective improved data is needed on contact patterns and importation rates outlined in annex 2.
- **Behavioural / clinical record linkage:** to investigate relative contributions of interconnectedness of hospital and care home sectors for disease spread and of the role of staff in transmission cycle. The role of staff is uncertain. Further studies should provide stronger evidence on contact rates within care homes between staff and residents, and between staff. The data linkage of swabbing test results for staff with place(s) of work (and ideally their role in the home) would be an important addition. Linkage of care home specific mortality data with the SGSS data will provide a platform for verification of both data-streams with datasets measures outbreak status and enable analysis to assess reliability of these datasets.
- **Whole Genome Sampling** has already been used in London over Easter and shown conclusively the hypothetical link to the role of staff in transmission cycle. It may be useful to assess whether linkage changes over time with hospital and staff roles as community epidemic recedes, and to help understand if care homes are driving hospital infections, visa versa or both.

SAGE Paper on Care Homes

BACKGROUND AND SOURCE MATERIAL

1. What is a care home?

1.1 A care home is a place where personal care and accommodation are provided together. People may live in the service for short or long periods. For many people, it is their sole place of residence and so it becomes their home, although they do not legally own or rent it. Both the care that people receive and the premises are regulated. This paper focuses on two categories of homes:

1.1.1 **Care Homes without Nursing:** Examples of services that fit under this category, includes Residential homes, Rest home, Convalescent home, Respite care, Mental health crisis house Therapeutic communities

1.1.2 **Care Homes with Nursing:** In addition, qualified nursing care is provided, to ensure that the full needs of the person using the service are met. Examples of services that fit under this category: Nursing home, Convalescent home with nursing, Respite care with nursing, Mental health crisis house with nursing

1.2 It is important to highlight, however, that there are also several other care homes, including specialist college services, domiciliary care services, extra care housing services, shared and supported living arrangements. All of these fall within the auspices of the Care Quality Commission.

1.3 In Scotland for adult care homes there: Older people; Learning disabilities; Mental health; Physical & sensory impairment; Alcohol dug misuse; Blood borne virus and Respite and short breaks homes. The Care Inspectorate does not distinguish between nursing and residential care homes reflecting the significant overlap in resident need. Domiciliary care services provide care at home to those with high need. Care home and care at home services are run by the private sector, voluntary organisations, local authority or National Health Service. More information about care homes in Scotland, and their residents, is available from the Scottish Care Homes Census and the Care Inspectorate.

2. The demographics of care homes

2.1 Some 400,000 older people live in care homes in the UK.[5], the majority of whom are over 80, and female (Figure 1).

[5] Age UK. *Later life in the United Kingdom 2019* Factsheet. https://www.ageuk.org.uk/globalassets/age-uk/documents/reports-and-publications/later_life_uk_factsheet.pdf

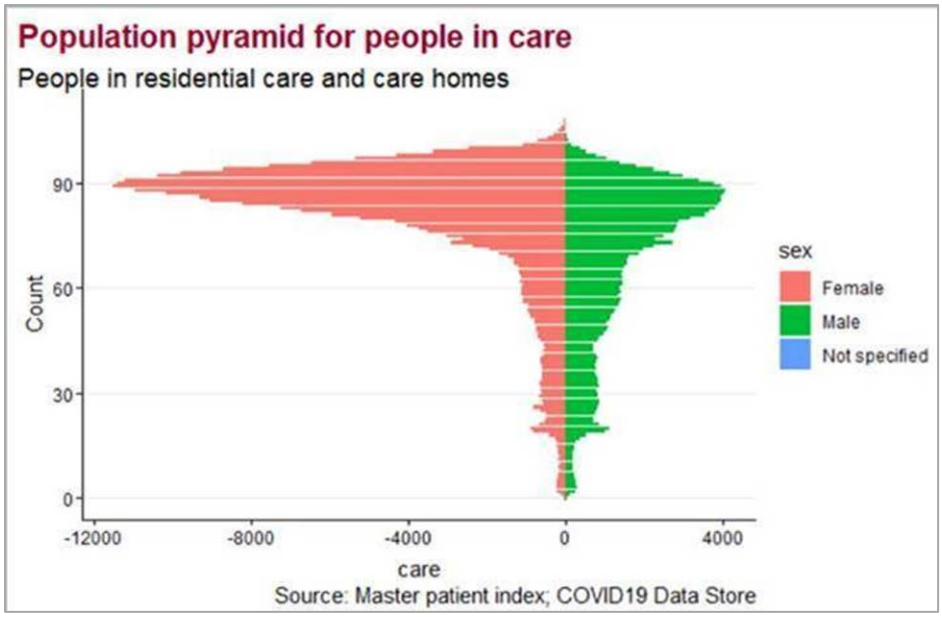

Figure 1: Population pyramid of people in care in the United Kingdom

England

In England there are 15517 care homes with 457,361 beds in total. The average number of beds is 29.5 per care home but the range is from a single bed to 215 beds. Table 1 shows the variation regionally by type of care home (residential or nursing) including recent outbreak numbers reported to PHE.

Table 1: Distribution of 15517 care homes by type and geographic region

Region	Residential or Nursing	Homes with outbreak	All homes	Percentage
East Midlands	Residential homes	224	1,127	19.9
	Nursing homes	203	416	48.8
East of England	Residential homes	304	1,285	23.7
	Nursing homes	205	391	52.4
London	Residential homes	213	1,020	20.9
	Nursing homes	256	368	69.6
North East	Residential homes	119	472	25.2
	Nursing homes	168	279	60.2
North West	Residential homes	324	1,287	25.2
	Nursing homes	362	633	57.2
South East	Residential homes	379	2,135	17.8
	Nursing homes	500	866	57.7
South West	Residential homes	208	1,509	13.8
	Nursing homes	247	544	45.4
West Midlands	Residential homes	227	1,206	18.8
	Nursing homes	269	490	54.9
Yorkshire and The Humber	Residential homes	249	1,076	23.1
	Nursing homes	204	409	49.9
England	**Residential homes**	**2247**	**11,120**	**20.2**
	Nursing homes	**2414**	**4,397**	**54.9**

Scotland

Table 2: Active adult care home services in Scotland

Active adult care home services[6]	1084 (now 1083)
Registered subtype	N (%)
Older people	817 (75.4)
Learning disabilities	155 (14.3)
Mental Health problems	53 (4.9)
Physical and sensory impairment	36 (3.3)
Other (alcohol & drug misuse, BBV, respite & short breaks)	23 (2.1)
Sector	N (%)
Private	681 (62.8)
Voluntary/not for profit	256 (23.6)
Local authority or Health board	147 (13.6)
Registered places	
Total	40,969
Average (Mean)	38
Range	1 to 225

2.2 Fewer care home residents or staff in Scotland are likely to be from ethnic minority groups than in England, due to the different underlying demographics of the countries.

3. The frailty and vulnerability of people living in care homes

3.1 Frailty can be defined as "a state of increased vulnerability to poor resolution of homeostasis following a stress, which increases the risk of adverse outcomes. It is a long established clinical expression that implies concern over an older person's vulnerability and prognosis."[7] Frailty is more prevalent amongst women than men and increases steadily with age: 65-69 years: 4%; 70-74 years: 7%; 75-79 years: 9% 80-84 years: 16%; >85 years: 26%.[1]

3.2 Frailty is often conceived as being on a graduated scale- robust, pre-frail, mild, moderate, severe. The prevalence of frailty in residential care and residential care with nursing facilities is very high, given that inability to cope, and deficits in activity of daily living are a major reason for admission to these facilities. Estimate range dramatically depending on measurement instruments used, country etc ranging from 19-76% with meta-analysis revealing about half of residents are frail.[8]

3.3 There are two key models of frailty:

3.3.1 Fried's Phenotype model[9], (determined by presence of ≥3 of 5 criteria, slow gait speed, low energy expenditure, self-reported exhaustion, unintentional weight loss and weak grip strength) and

[6] Based on Care Inspectorate Tables, February 2020, available from: https://www.careinspectorate.com/index.php/publications-statistics/93-public/datastore (accessed 14/4/20)
[7] Clegg A, et al. Frailty in elderly people. *Lancet*. 2013 381: 752–762 doi:10.1016/S0140-6736(12)62167-9.
[8] Kojima G. Prevalence of frailty in nursing homes: A systematic review and meta-analysis. *Journal of the American Medical Directors Association*, 2015; 16, 940 – 945. http://dx.doi.org/10.1016/j.jamda.2015.06.025
[9] Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; 56: M146–56. doi: 10.1093/gerona/56.3.m146

3.3.2 Rockwood's Cumulative Deficit Model[10], based on the accumulation of 'deficits' where the frailty score reflects the proportion of deficit criteria present to create a Frailty Index. This later approach is widely used in UK general practice.[11]

3.4 In response to COVID-19, NICE published guidance that on admission to hospital adults should be assessed using the Clinical Frailty Scale as part of the assessment to decide which patients need will likely benefit from critical care so as to make the best use of NHS resources.[12]

3.5 Old age and frailty have been associated with the most adverse outcomes for COVID-19 with the highest case fatality ratios found amongst the oldest groups.[13]

3.6 In any response to COVID-19 outbreak in a residential care home or residential care home with nursing the implications of moving residents will require careful consideration. It has long been accepted that moving residents of care homes is associated with increased mortality, with up to 25% excess 6 month mortality reported in residents who moved compared to control[14], although excess mortality can be minimised with well-planned and organised moves. There is evidence on what elements of a move produce the greatest stress, which individuals are most likely to be vulnerable and which procedures minimise stress and improve outcomes. Jolley *et al.*[15] list best practice for enforced relocation; from pre-move planning through relocation and follow-up measures so as to reduce stress and improve outcomes for residents who have to be moved.

Trends in deaths in care homes (CQC data)

3.7 CQC report mortality to DHSC on a daily basis separated by COVID19 and all cause deaths. This is at least 2 days lagged from present day. At present the data is presented at upper tier local authority as smallest spatial scale. Plans are in place with ONS to report at care home level which will be critical for verifying other data streams and understanding dynamics. The data is presented by date of notification to CQC not date of death. Figure 2 shows the all-cause mortality in care homes since start of April until the 5th May, daily numbers effectively doubled before decreasing in late April but more recently the model predicts the data may be plateauing again. Figure 6 shows the daily number of confirmed COVID19 deaths since 10th April to 5th May the model predicts that confirmed COVID19 reports are plateauing.

[10] Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005; 173: 489–95. doi:10.1503/cmaj.050051

[11] NHS:E *Identifying frailty*. https://www.england.nhs.uk/ourwork/clinical-policy/older-people/frailty/living-with-frailty/

[12] National Institute for Health and Care Excellence. *COVID-19 rapid guideline: critical care in adults NICE guideline.* [NG159] Updated: 29/04/2020 https://www.nice.org.uk/guidance/NG159

[13] Verity R et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. *The Lancet Infectious Diseases*, 2020 https://doi.org/10.1016/S1473-3099(20)30243-7

[14] Holder J, Jolley D. Forced relocation between nursing homes: Residents' health outcomes and potential moderators. *Reviews in Clinical Gerontology*, 2012; 22, 301-319. doi:10.1017/S0959259812000147

[15] Jolley D et al Enforced relocation of older people when Care Homes close: a question of life and death?, *Age and Ageing*, 2011; 40, 534–537, https://doi.org/10.1093/ageing/afr052

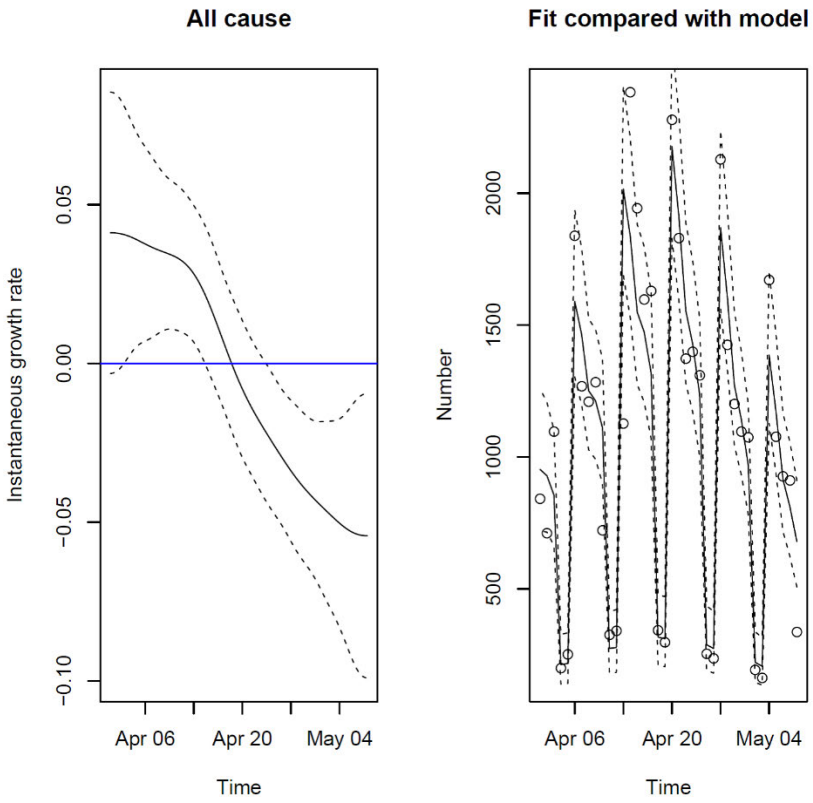

Figure 2: Daily all-cause mortality notified to CQC (right) and the instantaneous growth rate derived from the GAM (left)

Right pane: Daily all-cause mortality notified to CQC (by date of notification, black hollow points), with generalised additive model (GAM) fitted to the data (solid black line) and 95% Confidence Interval on model (dashed lines).

Left panel: The instantaneous growth rate derived from the GAM (black curve and dashed lines for 95% confidence interval), the blue line is zero growth for context. If blue line sits within dashed lines this suggests the data is neither increasing nor decreasing over time.

4. Current testing results

4.1 PHE undertook sampling of a number of care home with suspected outbreaks in London in early April. A separate paper has been submitted on the key findings from this investigation.

4.2 In another study in care homes in Liverpool, testing was offered to all residents in care homes that did not have outbreaks of COVID-19. This was augmented with the introduction of a daily electronic reporting system of new symptomatic residents / staff. At the beginning of the surveillance project (24 April 2020), 56/90 (62%) care homes in Liverpool had been affected by COVID-19 outbreaks. All 34 unaffected care homes agreed to take part, and consent was obtained from all residents. Results from 717 residents tested across all 32 homes is provided in Table 3. In summary, 15.6% of these care homes had one or more resident testing positive for COVID-19 (95% CI 5.3-32.8%); and 1.7% of all residents tested positive (95% CI 0.9-2.9%). The prevalence of positive residents in each home ranged from 0% to 20%. Of the five care homes reporting positive results, two had a single resident who had tested positive as an inpatient. One had a high number of staff absent recently due to illness in addition to a couple of residents with chest infection. Though insufficient to draw conclusions, these anecdotes suggest that there may be harbingers of infection going undetected.

4.3 Swabbing has been conducted in other settings and entered into the PHE SGSS system. All SGSS lab confirmed cases per 100,000 (of whole population) can be calculated and this shows a linear relationship with the percentage of care homes reporting an outbreak in each PHE centre (Figure 3). This suggests a strong link between community and care homes.

Table 3: Summary results of 32 reporting care homes

	No. Reporting	**No. Negative**	**No. Positive**	**% Positive (95% CI)**
Care Homes	32	27	5	15.6% (5.3-32.8%)
Residents	717	705	12	1.7% (0.9-2.9%)

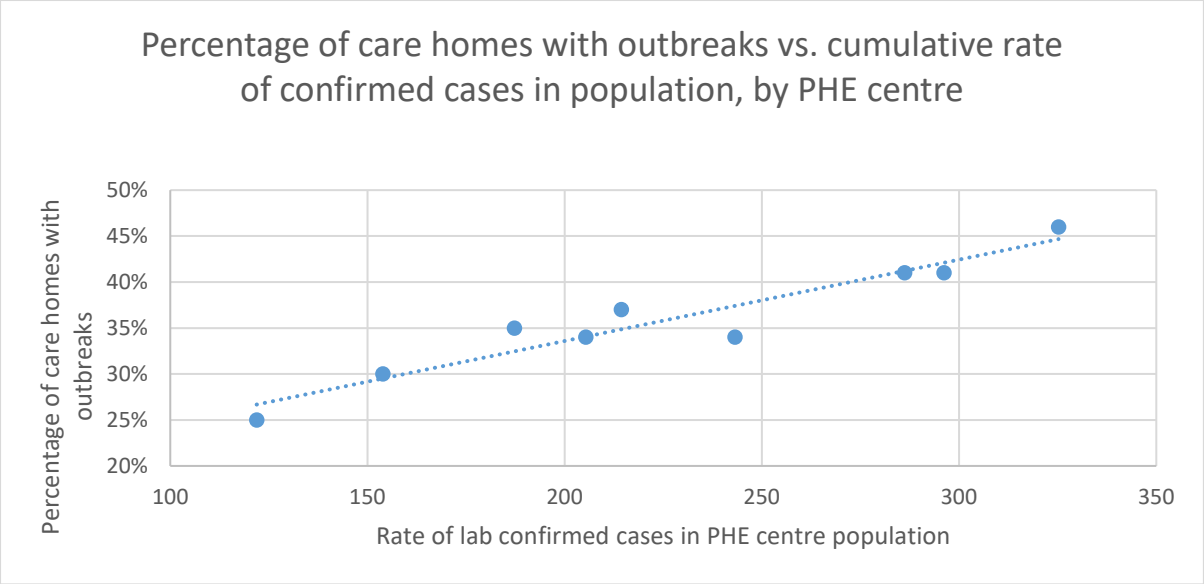

Figure 3: Relationship between community and care homes with outbreaks

<u>Key messages from Liverpool investigation</u>

4.4 The testing programme for residents of care homes without outbreaks was highly valued by staff regardless of the results as it gave them confidence on the current IPC measures and made them think critically about the overall infection control measures in the home.

4.5 15% care homes initially thought to be unaffected had at least one positive case, indicating that a window of opportunity still exists to prevent introduction of COVID-19 into the rest of the care homes, i.e. through testing and daily monitoring.

4.6 This work highlights that a high level of multifaceted support and training is needed for the care home sector including those without outbreaks during the COVID-19 pandemic period

4.7 Extending the testing programme to care homes without COVID-19 outbreaks across the North West and beyond will yield significant benefits to these high-risk settings with vulnerable residents.

4.8 This project has established a system and protocol that can be easily adapted by other local authorities.

5. Spatial distribution and within care home outbreaks

5.1 The household structure and semi-closed (yet interconnected) nature of the care home sector make homes especially vulnerable to high attack rates during infectious disease outbreaks[16]. Risk is however not uniform and is affected by household size and composition, (e.g., small care homes can have higher incidence of influenza outbreaks than larger ones)[17].

5.2 UK care home residents are primarily >80y [18], thus in the age group with the reported highest mortality rates for COVID-19, and considerable outbreaks are being reported in the sector worldwide[19].

5.3 While the particular kind of society (prison, care home, school, barracks, etc.) was not a significant factor in an adjusted model of attack ratio, a person's occupation within the society was[20]. In particular, children and military personnel suffer a greater attack ratio than other occupational types (staff, prisoners, etc.). There was no temporal trend in final attack ratio nor, with the exception of 1918, do pandemic years show abnormal attack ratios.

5.4 Figure 3 is taken from Finnie *at al.*[21] and shows the variability of attack rates by types of occupation in enclosed societies. Whilst variable there is a general trend to be lower as population size increases. These lines are only indicative (the model would tend to zero eventually as population increases). Community attack ratios are hard to find authoritative contemporary estimates for but the Reasonable Worst-Case scenario (and general planning assumptions) is for the wider community on average. One should keep in mind that smaller enclosed societies are akin to households and so the community attack ratio would be a mix of households that are severely attacked and some with no infection.

5.5 The attack ratio in a society will depend on the social structure and mixing. However, for planning purposes attack rates higher than the population RWC should be planned for. The ability to isolate cases and distance contacts within society may be important in this assessment though.

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[20] Finnie TJR; Copley, VR; Hall IM; Leach, S (2013), An analysis of influenza outbreaks in institutions and enclosed societies, *Epidemiology and Infection* 142(1): 107-113. https://www.cambridge.org/core/journals/epidemiology-and-infection/article/an-analysis-of-influenza-outbreaks-in-institutions-and-enclosed-societies/67E68EF3DCFCC268199DDE481A7F3B63

[21] Finnie TJR; Copley, VR; Hall IM; Leach, S (2013), An analysis of influenza outbreaks in institutions and enclosed societies, *Epidemiology and Infection* 142(1): 107-113. https://www.cambridge.org/core/journals/epidemiology-and-infection/article/an-analysis-of-influenza-outbreaks-in-institutions-and-enclosed-societies/67E68EF3DCFCC268199DDE481A7F3B63

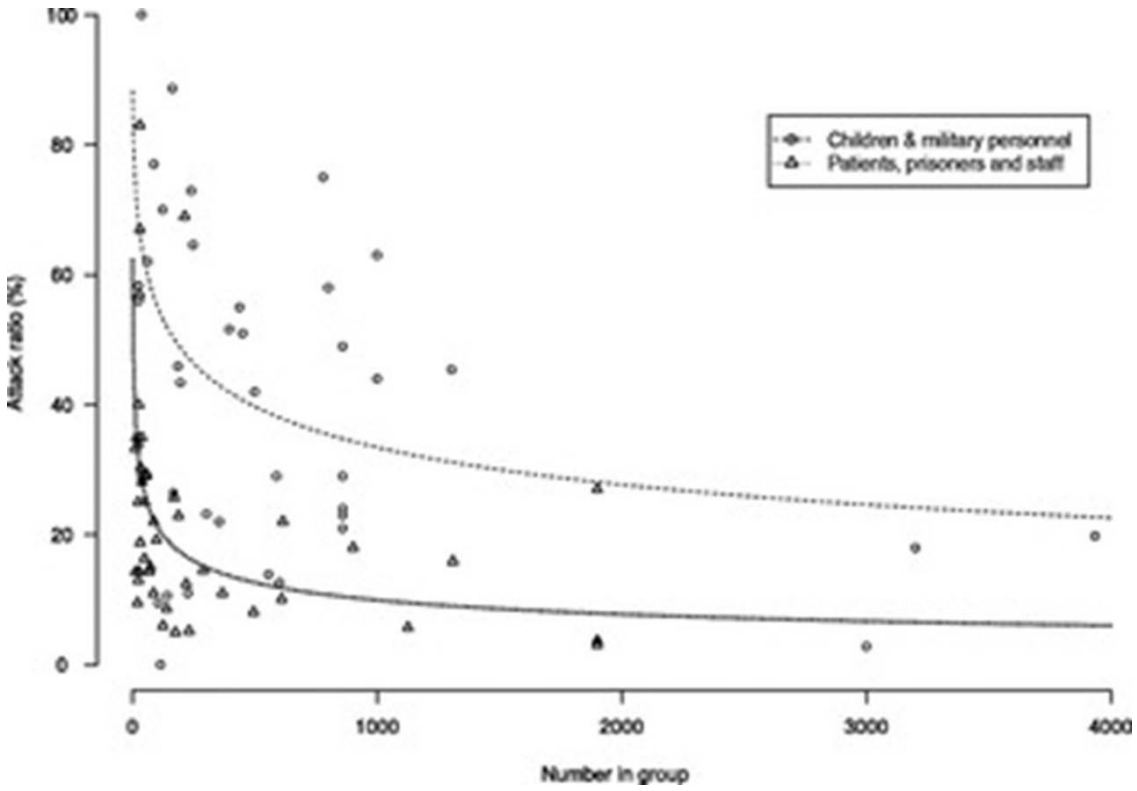

Figure 4: Taken from Finnie et al.[22], graph showing final attack ratio given size of enclosed society

6. Existing data on swabbing, testing and reports of cases

Swabbing data

6.1 This is a line list of all positive and negative swabs taken and reported to PHE giving the postcode location and date of swab being taken. The matching to postcode may be imperfect and may pick up community tests and larger care homes spread over multiple postcodes may miss some cases. However simple visualisation has shown this to be a very useful epidemic modelling data set.

6.2 Figure 7 shows the swab tests over time for a single care home of size 113 beds. Note that recently about 70 negative and 10 positive swabs were taken. Otherwise there are clear gaps in the left hand timeseries. Such gaps can be explained in the following ways: 1) there was a false negative test result; 2) the care home suffered a new importation of disease; or 3) there was a missing transmission link. We have negative tests results and so can consider false negatives in future analysis. Missing transmission links may be due to staff (who even if tested wouldn't show in this data feed unless they live in the home), an absence of testing during that period or asymptomatic transmission.

[22] Finnie TJR; Copley, VR; Hall IM; Leach, S (2013), An analysis of influenza outbreaks in institutions and enclosed societies, *Epidemiology and Infection* 142(1): 107-113. https://www.cambridge.org/core/journals/epidemiology-and-infection/article/an-analysis-of-influenza-outbreaks-in-institutions-and-enclosed-societies/67E68EF3DCFCC268199DDE481A7F3B63

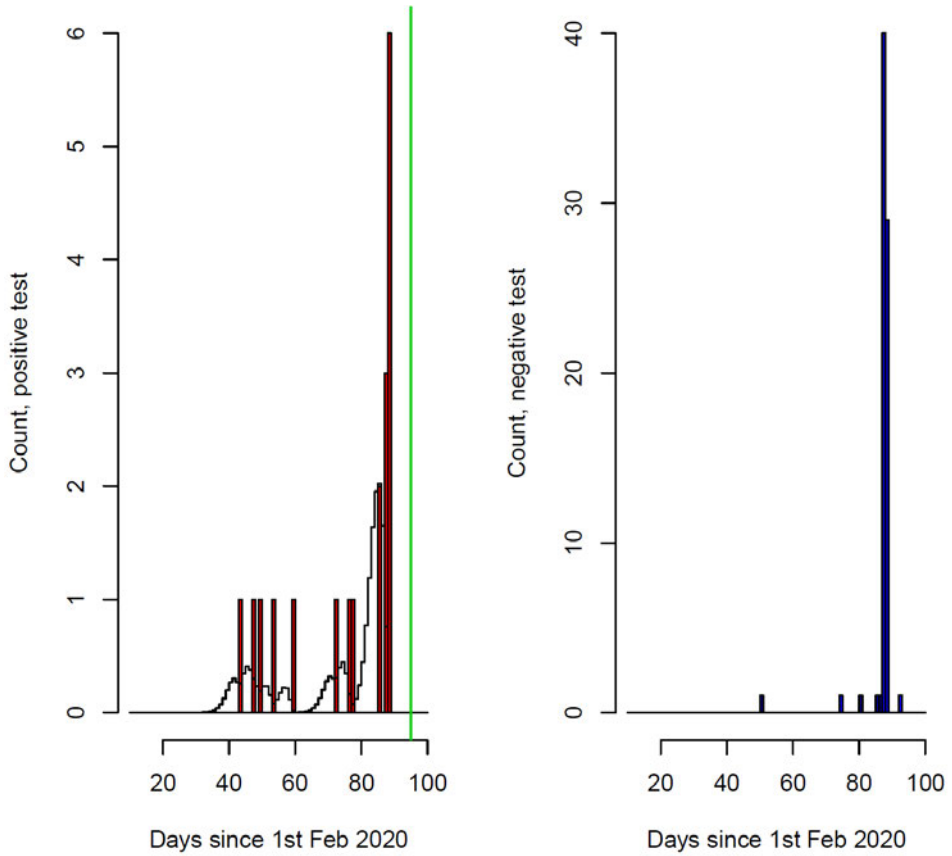

Figure 5: Illustrative care home specific swabbing data from the PHE SGSS system. Left panel - positive swabs, Right panel - negative swabs over time in same care home. Green vertical line is a reference marker for 5th May (the most recent date of swab test specimen being taken in the line list).

i) We may link the SGSS data up with the CQC list of all care homes to calculate the number of positive swab tests in a postcode and the number of care home beds in a postcode. Figure 6 show that about 10% of smaller care homes have reported a swab positive result but around 80% of larger care homes have reported at least one swab positive result.

ii) Figure 7 shows the absolute number of positive swab tests give a care home size is increasing as number of beds increases, seemingly levelling off at larger care home sizes. However, caution is needed here as the outbreaks are not completed and so further swab positives may be expected and given testing to date may underestimate actual cases to date.

iii) With the same caution that the outbreaks to-date may not be complete due to ongoing transmission and later reintroduction of disease, Figure 8 shows comparison of the maximum time period between positive swabs in care homes with a given number of positive swabs (top left) and given number of beds (bottom left) along with similar plots for the current duration (time from first positive swab to most recent) of outbreaks (right panels). These show trends increasing with outbreak or care home size, though the maximum gap between positive results is a constant of about 10 days.

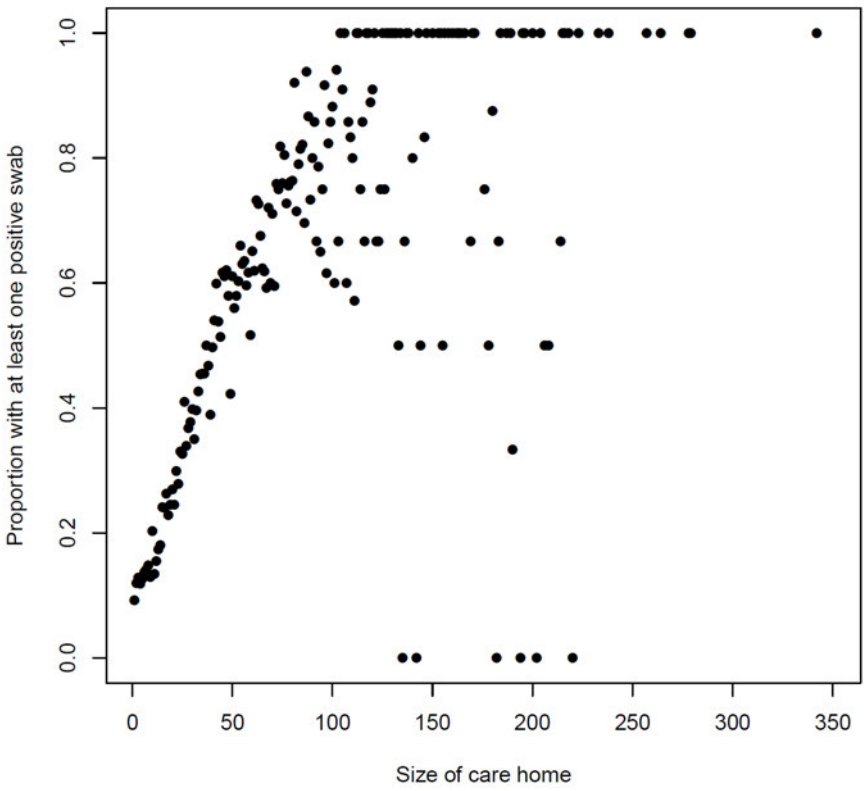

Figure 6: Proportion of care homes of given size (by postcode rather than home itself) that have had at least 1 positive swab result

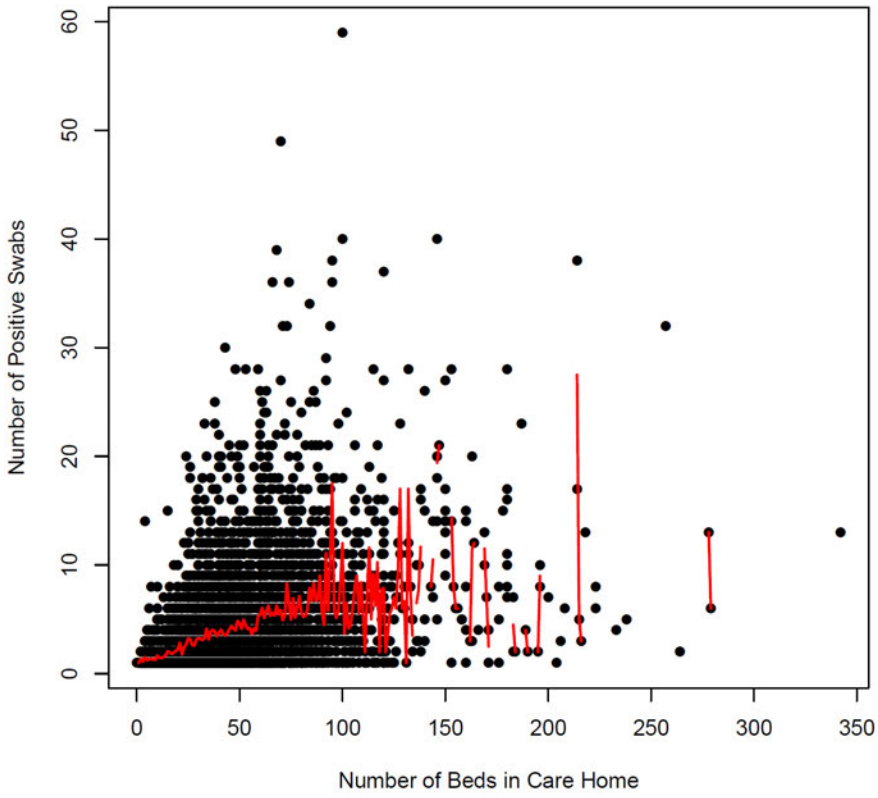

Figure 7: Number of positive swab tests by number of beds in a postcode (black dots), red line the mean given care home size

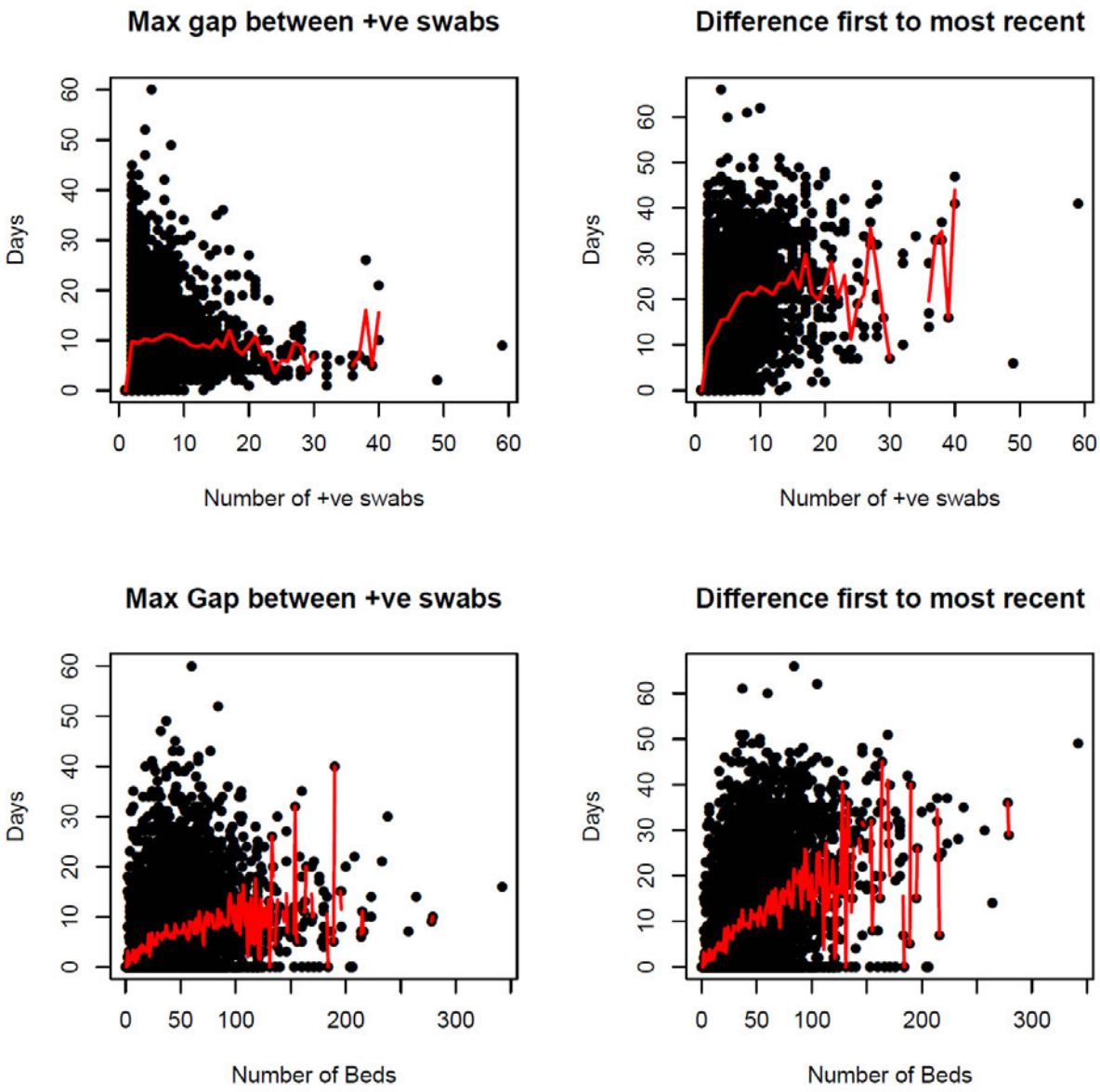

Figure 8: comparison of the largest gap between positive swabs and the duration of outbreaks to date by outbreak size and care home size.

Capacity Tracker

6.3 Capacity tracker (CT) is designed to allow care homes to report outbreaks to NHS web system. Not all care homes use it (about 9900 out of 15000), but those that do can be mapped to postcode level detail through merging with CQC UID. There is some information about staff absence (by nurse, care work and non-care workers) as well as number of cases in each home and current capacity. This seems excellent if the Care Home user base is stable. It can be updated and so changed day on day by homes may be a sign of epidemic curve. However, ground truthing this data with the local perspective in Liverpool gave almost twice as many 'on the books' of local team but that may be lags in report and the fact the tracker isn't comprehensive in use.

6.4 Statistical modelling (conducted by Marcello Morciano, University of Manchester) on this data suggests CT data are not fully representative of all care homes active in England. Care homes providing nursing services are more likely to participate in the CT programme and therefore

over-represented in the CT data, but the significance of the effect reduces once controlling for care home beds capacity. Bigger care homes are more likely to be observed (over-represented) in the CT data. Care homes supporting residents with dementia are under-represented in the CT data. Also care homes that provide services to children 0-18 are under-represented but this is weakened once accounting for the clustering of care home within LAs. Chained/Branded care homes are over-represented as well as those located outside London. NHS care homes less likely to be in the CT data. Care homes requiring improvement are under-represented as well as those experienced a change in management (since last CQC rating).

6.5 Capacity tracker is not available in Scotland

HPZone data

6.6 HPZone data is curated by PHE CROC each day and gives number of care homes reporting outbreaks in PHE centres and regions. There is further detail on residents and staff within database. This may be more timely and complete than capacity tracker as HP team curate data rather than care home pushing data. As of 9/5/2020 5524 care homes in England reported a confirmed or suspected outbreak of COVID19 meaning 36% of care homes nationally have reported an outbreak.

6.7 Merging data from HPZone and SGSS Figure 9 shows the proportion of care homes reporting an outbreak for different sizes and split by are home type nursing or residential

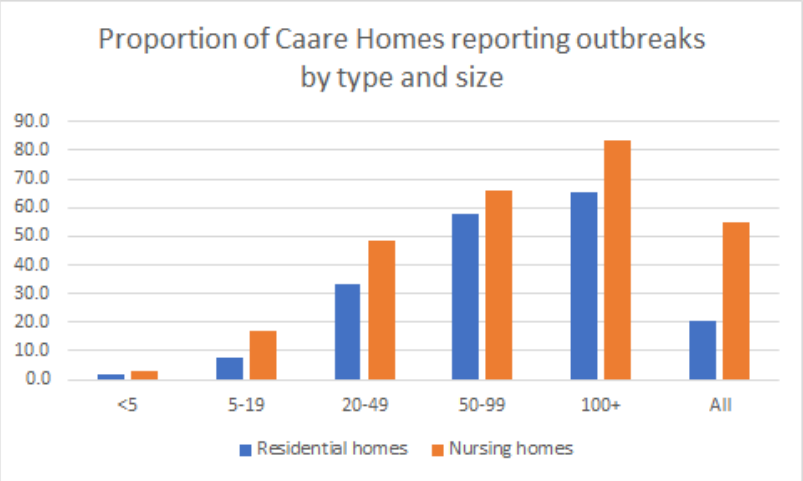

Figure 9: The proportion of care homes reporting an outbreak for different sizes and split by are home type nursing or residential

6.8 Figure 10 shows the spatial distribution of these outbreaks in England with clear local foci of outbreaks in Liverpool and Oxfordshire in terms of proportion of care homes suffering an outbreak.

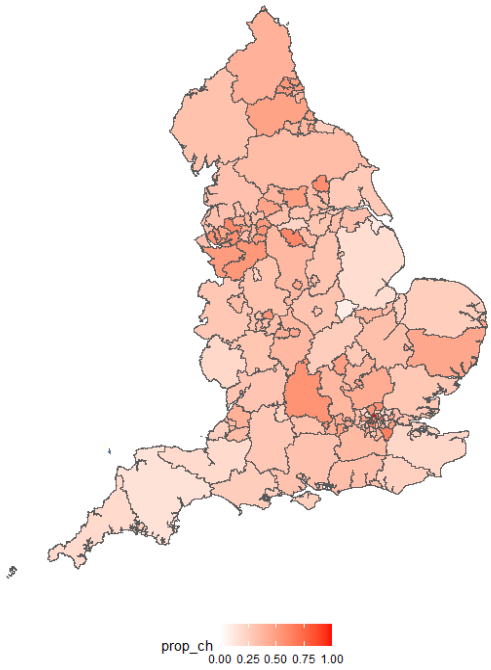

Figure 10: Suspected or confirmed Covid-19 outbreaks in care homes in England (shading based on the proportion of care homes with suspected or confirmed outbreaks per Local Authority as of 2020-05-05)

6.9 The HPZone data was the basis of the modelling reported at previous SPI-M suggesting 75% of care maybe suffering an outbreak concurrently eventually inferred from the pattern of increase in newly reported outbreaks. [23]

6.10 A richer dataset is available which includes the number symptomatic at time of report (hereafter called InFact dataset). This can be linked to the other datasets and potentially provide a useful verification dataset.

Scotland

6.11 Mortality & outbreak data – at care home level, available from Care Inspectorate based on notifications; change in recording practice mid-April onwards will improve data quality. Additional staffing data also collected in-parallel.

6.12 Baseline population data on long-stay (>6 weeks) residents available for March 2018-Feb 2019 – from Scottish Care Home Census. Example of information available summarised: https://www.rcpe.ac.uk/sites/default/files/jrcpe_49_1_burton.pdf

6.13 Scotland: information about the number of care homes with COVID cases in Scotland are available on the Scottish Government website.

HDRUK and other data sources

6.14 There are a number of research projects being repurposed or set up, all based on routine data with some complemented and enriched by survey or interview data. Important challenges in this context include difficulty defining the denominator care home population, live data linkage, and linking staff data to care homes. Key gaps include difficulty identifying care-at-home populations and detailed understanding of individual care homes (built environment,

[23] Hall, et al, MedRxiv, 2020, https://www.medrxiv.org/content/10.1101/2020.05.07.20089243v1

staffing patterns, care interactions, staff movement between care homes) and residents (data on symptoms, observations, frailty etc). Available datasets include routine data with care home populations identified by address matching or other methods, and care service electronic care record data. These projects will be able to:

6.14.1 Describe the care home population in terms of vulnerability

6.14.2 Better understand outbreaks in care home residents and on individual care homes in terms of immediate COVID impact

6.14.3 Better understand the impact of lockdown on non-COVID care pathways and outcomes

6.15 *HDR North Digital Care Homes* [redacted]. Repurposing of an existing study of referral to health services (1) Detailed data about residents with cause for concern and subsequent care pathways, will examine referral patterns, pathways of care, and mortality before and during lockdown. (2) Qualitative interviews with care home staff, residents/carers and NHS staff examining changes in staff decision making before and during lockdown.

6.16 *UCL* [redacted]. (1) Electronic care record data from one care home provider with ~200 care homes with ~9500 residents, to examine: COVID rates, deaths and hospital admissions; other variables needed for modelling such as bed occupancy; estimates of indirect mortality; whether hospital discharge to care home is associated with outbreak initiation. (2) Care home staff survey including insights into under-reporting based on test data. (3) Qualitative interviews with key stakeholders.

6.17 *Scotland* [redacted]. (1) Extend previous work to identify the care home population using data science methods for address matching. Initially in two health boards (population ~750K) but should be usable in other contexts. (2) Negotiating access to data to identify the local authority funded care-at-home population in one health board (population ~800K) (3) For 1 and 2, can link to resident COVID testing, mortality, and other routine NHS data to examine COVID impact. (4) Negotiating access to electronic care records for ~200 care services but not linkable. Annex 3 illustrates the characteristics of care homes in a single health board.

6.18 *South West* [redacted]. Linked primary and secondary care data for ~1M people with ~5000 identified as care home residents through address matching. Ongoing work to flag social care workers in the dataset which will allow examination of transmission dynamics between residents and staff with detailed data for both on demography, morbidity and prescribing.

7. Environmental transmission in care homes

7.1 There appears to be very little data on the role of the physical environment on infection risk within care homes, but the small number of studies suggest it is important. A systematic review by Joseph[24] identified only two studies that focused specifically on HAI in care home

[24] Joseph, A., Choi, Y. S. and Quan, X. (2016) 'Impact of the Physical Environment of Residential Health, Care, and Support Facilities (RHCSF) on Staff and Residents: A Systematic Review of the Literature', *Environment and Behavior*, 48(10), pp. 1203–1241. doi: 10.1177/0013916515597027.

environments. They noted that a Dutch study by Eilers *et al.*[25] unexpectedly found that shared rooms reduce HAI risk, but this doesn't align with hospital studies[26] or modelling[27]. Eilers suggest that in private rooms patients are more likely to have co-morbidities that make them susceptible to infection. A study based on 59 nursing homes and records of 2015 residents identified that facilities with low scores on cleanliness, odour, noise, home-likeness and environmental quality were associated with a higher HAI risk[28]. Joseph *et al.*[29] flag environmental causes of HAI in nursing homes as a key research gap.

7.2 Curran[30] presents a detailed discussion of IPC in care homes, including for outbreaks and acknowledges the role of the environment in transmission, particularly shared surfaces. Cousins[31] focuses on hand hygiene and decontamination (particularly of equipment that is shared) to prevent HAI. He flags that knowledge about the infection, appropriate cleaning solutions and frequency of cleaning among care workers contributes to risk. Pineles[32] observe physical contact patterns between people and the environment in common areas in US care homes. As shown in the figure resident-resident contact is very small, but other contacts are significant. They recommend common areas should be a greater focus for IPC as most guidelines focus on protocols within resident's rooms.

[25] Eilers, R., Veldman-Ariesen, M. J., Haenen, A., & van Benthem, B. H. (2012).Prevalence and determinants associated with healthcare-associated infections in long-term care facilities (HALT) in the Netherlands, May to June 2010. *Eurosurveillance*, 17(34), 13-18.

[26] Ulrich, R., Zimring, C., Zhu, X., DuBose, J., Hyun-Bo, S., Choi, Y.-S., . . . Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. *Health Environments Research & Design Journal*, 1(3), 61-125.

[27] King, M.-F. M.-F., Noakes, C. J. and Sleigh, P. a. (2015) 'Modelling environmental contamination in hospital single and four-bed rooms', *Indoor Air*, 25(6), pp. 694–707. doi: 10.1111/ina.12186.

[28] Zimmerman, S., Gruber-Baldini, A. L., Hebel, J. R., Sloane, P. D., & Magaziner,J. (2002). Nursing home facility risk factors for infection and hospitalization:Importance of registered nurse turnover, administration, and social factors .*Journal of the American Geriatrics Society*, 50, 1987-1995. doi:10.1046/j.1532-5415.2002.50610.x

[29] Joseph, A., Choi, Y. S. and Quan, X. (2016) 'Impact of the Physical Environment of Residential Health, Care, and Support Facilities (RHCSF) on Staff and Residents: A Systematic Review of the Literature', *Environment and Behavior*, 48(10), pp. 1203–1241. doi: 10.1177/0013916515597027.

[30] Curran, E. T. (2017) 'Infection outbreaks in care homes: prevention and management.', *Nursing Times*, p. 77. Available at: http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=127120230&site=ehost-live.

[31] Cousins, G. (2016) 'Role of environmental cleanliness and decontamination in care homes', *Nursing standard (Royal College of Nursing (Great Britain) : 1987)*, 30(19), pp. 39–43. doi: 10.7748/ns.30.19.39.s42.

[32] Pineles, L. *et al.* (2019) 'Frequency of nursing home resident contact with staff, other residents, and the environment outside resident rooms', *Infection Control and Hospital Epidemiology*, 40(7), pp. 815–816. doi: 10.1017/ice.2019.117.

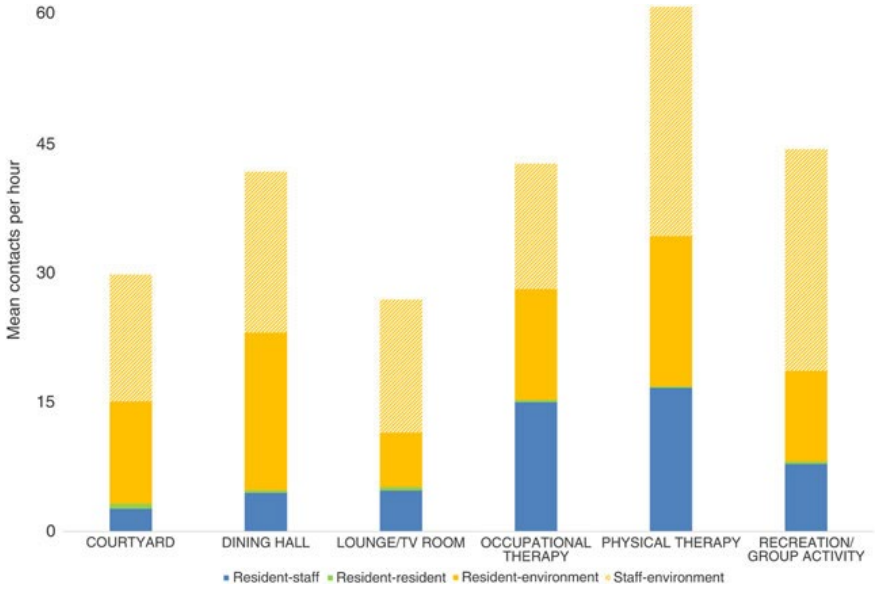

Figure 11: Mean contacts per hour in different care home settings[33]

Recommendations

7.3 Action now: review current IPC guidelines in care homes against current knowledge of transmission mechanisms and mitigation actions, and update to address any gaps. EMG environmental transmission papers, new paper on hospitals has been shared to support this, EMG are currently looking at evidence for practical mitigations and will share ASAP.

7.4 Short to medium term: Collect data on the environment in care homes as part of surveillance studies:

7.4.1 At a national level/within a survey project include questions on the physical environment (e.g., age of building, area/resident, typology/layout, ventilation, connectivity to other buildings) alongside data on cleaning/IPC and staff movement together with case data. Could allow identification of any risk factors.

7.4.2 Add physical environmental data collection into environmental (air and surface) sampling studies – EMG are planning to put together a funding application to do this alongside a PHE study that is expected to undertake sampling in care homes in the South West.

7.4.3 Include physical environment parameters as part of the post outbreak analysis for care home outbreaks – talking to PHE we think there may be some data to enable this and will include within funding application.

[33] Pineles, L. *et al.* (2019) 'Frequency of nursing home resident contact with staff, other residents, and the environment outside resident rooms', *Infection Control and Hospital Epidemiology*, 40(7), pp. 815–816. doi: 10.1017/ice.2019.117.

8. Annex 1: Epidemic Model structures

8.1 TO date there has been limited analyses, using epidemiological models, to consider patterns and drivers of transmission in care homes. A number of model structures exist that may be used. The modelling group is universal in agreeing it is only appropriate to consider stochastic models within care homes given the population sizes involved. Each group has a model in varying degrees of readiness (listed below in rough order of readiness with lead institution given, where no institution is named the model was discussed as hypothetically credible but not yet developed).

- 8.1.1 LSTHM Compartmental Stochastic model; Staff interaction pending but with structure for swab testing (see annex 1a for further detail)
- 8.1.2 UoM Compartmental Stochastic Model; Simple model within care home but connection to outer pandemic wave[34].
- 8.1.3 PHE Compartmental Stochastic Model; Additional transit states may allow more realistic transition but less detailed infection states
- 8.1.4 UoM Network model; Simple network to qualitatively match observed lab data but no staff or testing.
- 8.1.5 Branching process model; Not developed yet, may give insight to transmission pathways
- 8.1.6 Individual based simulation; Possible to adapt UoM models but depends on data.
- 8.1.7 Meta-population model; May be critical for understanding between care home transmission.
- 8.1.8 UoM Statistical regression modelling under development to verify Capacity Tracker..

Ways forward for model parameterisation

8.2 Annex 2 describes the types of data needed for effective modelling. This is a long list and will require bespoke research studies to identify most parameters. Much of this information is not known or setting specific. There are a number of ways forward:

- 8.2.1 A rapid literature review may find some of this setting specific data. For example, https://www.nature.com/articles/s41598-018-20008-w/ contacts in a rehabilitation LTCF prior to COVID-19 were used to parameterise a model looking at testing for COVID-19 in this setting -> https://www.medrxiv.org/content/10.1101/2020.04.19.20071639v1 https://ro.uow.edu.au/cgi/viewcontent.cgi?referer=&httpsredir=1&article=6244&context=eispapers

[34] Using statistics and mathematical modelling to understand infectious disease outbreaks: COVID-19 as an example
Christopher E. Overtona,k,1,————————————, Helena B. Stagea,1,————————————, Shazaad Ahmadf,m, Jacob Curran-Sebastiana, Paul Darke,n, Rajenki Dasa, Elizabeth Fearonc, Timothy Feltone,i, Martyn Fylesa,l, Nick Gentd, Ian Halla,d, Thomas Housea,b, Hugo Lewkowiczj,a, Xiaoxi Panga, Lorenzo Pellisa, Robert Sawkob, Andrew Ustianowskig,h, Bindu Vekariaa, Luke Webb, ArXiv, 2020

8.2.2 An observation study in a sample of care homes would be more effective in providing estimates of the contact rates and challenges faced by staff as it would be more timely and specific. Further data on demographics and infection severity in staff (swabbing results of staff linked to care homes directly) would add to situational awareness. Generality may not be possible.

8.2.3 Given challenge in bringing observers into home traditional survey may not be possible

i) Given challenge in bringing observers into home traditional survey may not be possible. An alternative option might be training care home staff to carry out structured observation or to collect survey data from other staff in the care home. Although training to do observation would be logistically challenging, many staff may welcome additional paid hours (especially if at a higher rate than their normal pay) and such staff will require less orientation to the environment than a researcher would. Training to collect survey data would be much more straightforward.

8.2.4 Email/web-based survey – uptake likely an issue and will cause a bias towards better resourced homes (where manager has more time to do paperwork). However, many care homes staff seeing how difficult the situation is first-hand may be willing to participate in research relating to trying to improve the way we tackle COVID. Given the socioeconomics of care home staff, paper survey options for staff to complete when leaving shift may be more feasible (not all staff will have e-mail or internet access, particularly older ones), or paying for a staff member to collect data from their workmates.

8.2.5 Telephone survey – only contact with manager who may skew responses.

8.2.6 Remote survey using CCTV or sensors – ethics may take too long, but this technology exists and would be stable for such a forensic investigation. Microbiological investigation.

8.2.7 Swabbing data: is already available from SGSS (see below, section 8.3) but staff not linked to care home(s) of work and testing is not a census survey, so we are unclear of the burden of infection from mild cases.

8.2.8 Serology:

i) may be useful to verify swabbing data.
ii) It could be used to investigate observed outbreaks to calculate asymptomatic burden of disease but would need to be used after a symptom tracking exercise within a setting.
iii) Could be used to sample care homes without reported outbreaks to check infection status.

Annex 1a: Technical details of within care home model

We used a stochastic compartmental model simulating transmission of SARS-CoV-2 in a LTCF, with flows from the LTCF to hospital and from the hospital to the LTCF (see schematic in Figure 13). We simulated transmission in two types of facility: a residential LTCF with 38 residents and a nursing LTCF with 59 residents (mean bed numbers in these facilities, Wolters et al. 2019). All residents were assumed to be initially susceptible. Clinical infection was divided into two periods, one with high infectiousness followed by one with low infectiousness, each of the same duration. This was to better characterise that viral load peaks at symptom onset and decreases rapidly (He et al. 2020).

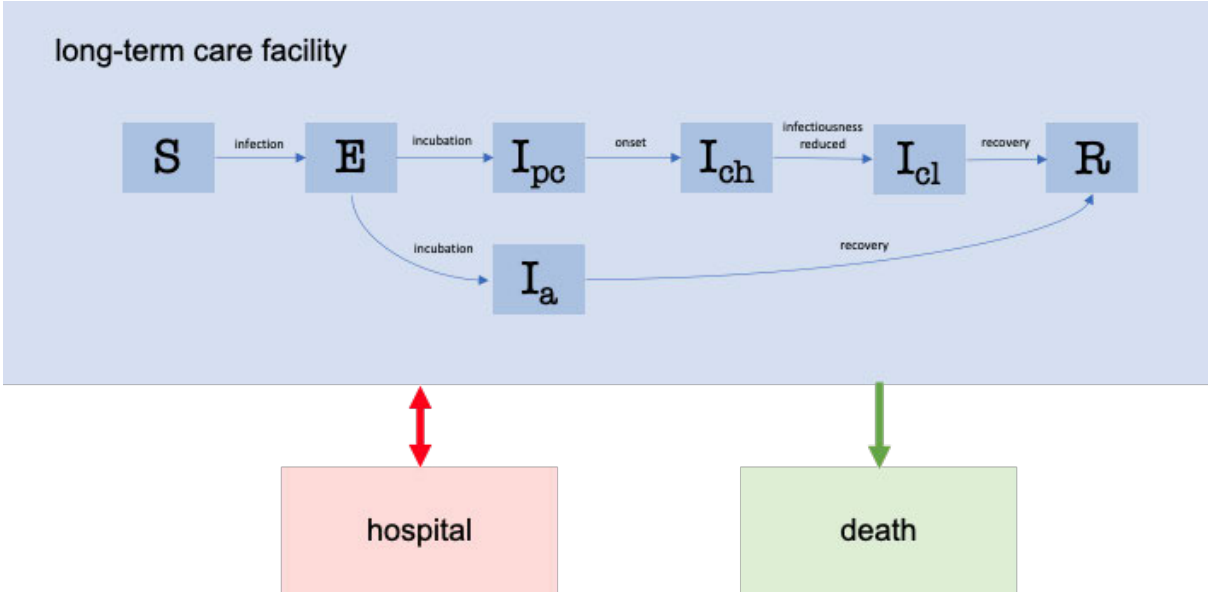

Figure 12: Model schematic of the SARS-CoV-2 infection process

Individuals were classified into susceptible (S), exposed (E1 and E2), infectious asymptomatic (Ia), infectious preclinical (Ipc), infectious clinical with high infectiousness (Ich), infectious clinical with low infectiousness (Icl), and recovered (R). Residents could exit the LTCF through dying (green arrow) or visiting the hospital (red arrow) and could enter the LTCF from the hospital (red arrow).

Residents exited the LTCF either by going to hospital (due to COVID-19 or other reasons) or dying, and were assumed to enter the facility exclusively from hospital, as it was assumed that during the time of the pandemic community admissions of residents to the LTCF were rare. We also assumed the proportion of residents leaving the LTCF to return to the community or transfer to another LTCF was negligible.

A proportion of residents p_i were isolated due to their clinical symptoms within the LTCF (baseline scenario 70%). Resident testing and isolation pathways are further described in Figure 14. When testing was introduced, which we assumed had 100% specificity and 90% sensitivity, all residents testing positive were assumed to be isolated with an effectiveness 1-m_i (baseline scenario 75%). There was an assumed delay of 1.5 days between testing and isolation in the baseline scenario.

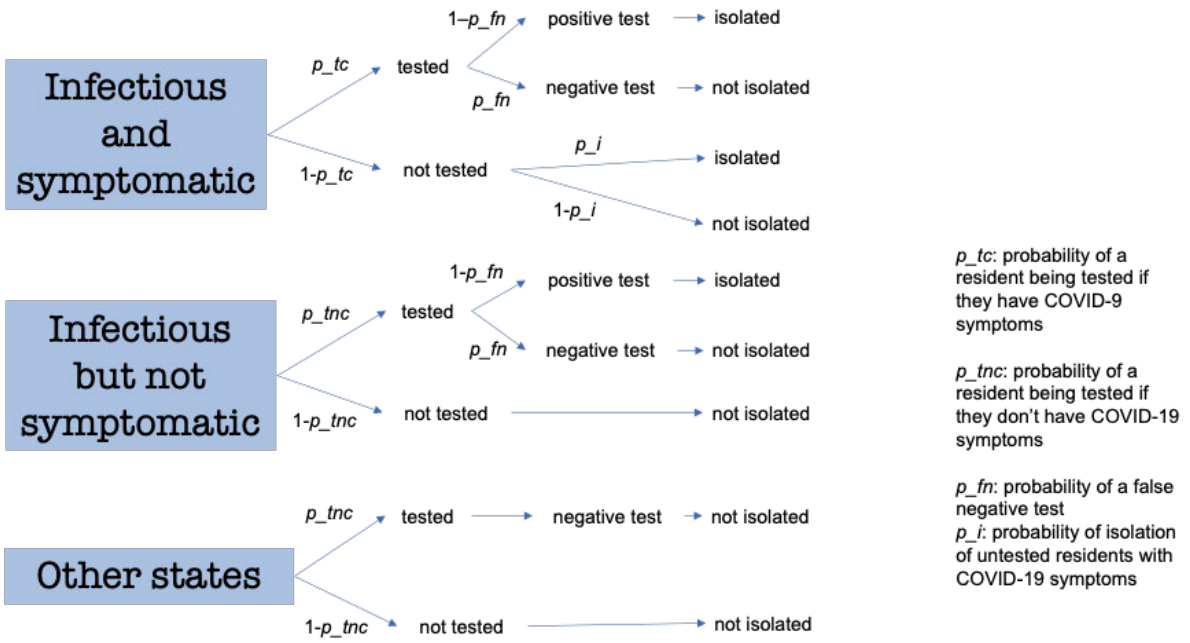

Figure 13: Testing and isolation pathway for residents in LTCFs. Isolation was assumed to be within the LTCF. The effectiveness of isolation was 1-m_i (75% in the baseline scenario)

Residents could be exposed to SARS-CoV-2 through contact with infectious residents or staff. The infection process in staff was similar to that in residents; however, symptomatic staff only contributed to the force of infection for 1.5 days, after which they became absent. Staff could also become absent due to a positive test. We assumed 2 staff were present per resident in nursing LTCFs and 1 staff per resident in residential LTCFs. Staff could be exposed to SARS-CoV-2 through contact with infectious residents, other staff, or in the community. We also assumed the same transmission rate for resident-resident, resident-staff, staff-resident and staff-staff due to a paucity of data to inform this further.

Annex 2: Data needed for epidemic models

Despite structural differences the model requires similar data to enable effective usage. We attempt below to list indicative parameters

Natural History parameters – mostly likely found in literature

1. Incubation period
2. Latency period
3. Infectious period
4. Fraction of cases that are asymptomatic (does this vary by age)
5. Duration of residency in setting

Transmission parameters – most likely setting specific and highly variable

1. Contact rates between staff
2. Contact rates between residents
3. Contact rates between staff and residents

Transmission parameters – most likely similar across settings

1. Probability of infection given each contact type.
2. Relative infectiousness of asymptomatic cases
3. Is environmental transfer important and other modes of transmission – link to Environmental Working Group.
4. Connectivity of care home to Hospital setting (transfers in and out) by setting.

Within Setting intervention parameter– most likely setting specific

1. Use of PPE (what is PPE)
2. Efficacy of PPE if used
3. Ability to isolate cases, and efficacy of that isolation. Is isolation dependent on capacity?
4. Ability to isolate residents and efficacy of that isolation
5. Ability to cohort staff to residents
6. Ability to follow advice from PHE (nationally or via local health protection teams)
7. Decontamination/cleaning practises.

Staffing – most likely setting specific

1. Number of staff
2. Number of staff on shift
3. Use of uniform/scrubs (related to PPE depending on definition of PPE)
4. Usage of contract/bank staff
5. Staff absence rate and how long they are absent.
6. Severity of infection in staff.
7. Demographics and risk factors in staff.
8. How frequently are absent staff replaced? Do these replacement staff work in multiple care homes?
9. Do staff contact rates change when there is high staff absence

10. Connectivity to other care homes (mutual aid/staff sharing/etc.) Number of staff working in other care homes and frequency of work.
11. Connectivity of staff with community (household size, age distribution). Residency of staff in care home
12. Connectivity of staff with the hospital (are they also hospital workers?)

Scotland

Information on the number of staff working in care homes is provided in Figure 4, with more detail (including demographic breakdowns) available from the Scottish Social Services Council (SSSC).

Staff absence rates due to COVID19, together with other information about care homes with COVID cases in Scotland are available on the Scottish Government website.

Table 4: Adult care homes in Scotland by category

Adult care homes by category	No. Care homes	Registered places	Staff (SSSC data)
Older people	817	37513	46,130
Learning disabilities	155	1567	3,680
Mental health	53	958	1,140
Physical & sensory impairment	36	572	1,910
Alcohol & drug misuse	14	285	350
Blood borne virus	1	10	10
Respite and short breaks	8	77	280
Totals	**1,084 (now 1083)**	**40,982**	**53,500**

Annex 3: Characteristics of care homes with at least one COVID+ resident in one Scottish health board

Summary

Data for 188 registered care home services in one health board, and 110 care homes for older people. The health board contacts services regularly to check if there are potential resident or staff cases, and provides rapid resident testing through an outreach team visit and rapid staff testing through an NHS run service. Care homes with outbreaks are given additional NHS staff support.

Testing and outbreaks (defined as at least one resident with a positive test) were more common in care homes for older people, which are systematically larger and very likely also have more physical contact between staff and residents.

Within care homes for older people, 90% had had at least one resident tested. Outbreaks (one or more residents with a positive test) were more common in care homes with more registered beds, and with higher levels of whole time equivalent staff. There was no association with local authority/integrated joint board location, or with Care Inspectorate quality ratings. There may be ascertainment bias in the association with number of beds.

Bruce Guthrie [redacted] 11/5/20

Data

In this health board, care homes are contacted regularly to ask about residents or staff with symptoms and to encourage testing through a visit from the outreach team. The Board has tested ~1500 care home residents of ~5000, and 43% were positive. In one care home with several positive residents, all staff were tested and 10% were positive, half asymptomatic. The Board records 64 care homes with one or more residents with a positive test (referred to subsequently as an outbreak), and 62 with at least one resident tested but no positive tests. The Care Inspectorate list of registered services[35] from 31/3/19 has 188 care home services of various types (includes children and young people).

Three care homes in the Board list are not in the Care Inspectorate list (one is named as unknown, one opened in summer 2019, and the other exists but isn't in the Care Inspectorate list – all have at least one positive case). The Care Inspectorate list also has two services at one address (one for older people and one for a more specialist population) where the Board list simply lists the common part of the name. Both were assumed to have cases in this analysis.

In the Care Inspectorate list, there are therefore 62 care home services with at least one positive resident, 62 with at least one test done but no positive residents, and 64 with no known testing (in principle, any care home with symptomatic cases is meant to contact public health to arrange testing, but we can't say for certain there are no symptomatic cases in residents in such care home services).

[35] https://www.careinspectorate.com/index.php/statistics-and-analysis/data-and-analysis

The analysis is a simple cross-tabulation of care home characteristics recorded by the Care Inspectorate and testing outcomes. Care home characteristic data is not available for all care homes services.

Findings

Table 5 shows results by care home subtype (as defined by Care Inspectorate registration). Testing is more common in services for older people, physical and sensory impairment, and learning disabilities. Almost all positive tests are in care homes for older people. There are systematic differences between different types of institution, with care homes for older people being much larger (median 40 beds, range 10-119) than other subtypes (children and young people median 5 beds, range 4-11; learning disabilities median 5 beds, range 4-11) which are often more like supported living environments than care homes per se. The subsequent focus is therefore on care homes for older people.

Table 5: Presence of positive tests by care home subtype

Care home subtype N=188	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
Older people N=110	10 (9.1)	42 (38.2)	58 (52.7)
Children & young people N=39	33 (84.6)	5 (12.8)	1 (2.6)
Learning disabilities N=26	16 (61.5)	8 (30.8)	2 (7.7)
Physical & sensory impairment N=9	3 (33.3)	6 (66.7)	0
Alcohol and drug misuse N=1	1 (100)	0	0
Blood borne virus N=1	1 (100)	0	0
Mental health problems N=1	0	0	1 (100)
Respite care & short breaks N=1	0	1 (100)	0

X^2=103.9, df=14, p<0.001 (small expected counts in many cells)

Care homes for older people

Testing is more common in care homes with more beds (Table 6) and in care homes with higher numbers of whole time equivalent (WTE) staff reported to the Care Inspectorate. The presence of one or more residents with a positive test was also more common in care homes with more beds, and to a lesser extent in care homes with higher numbers of WTE staff. 85% of care homes for older people with 63-119 beds had at least one positive resident, compared to 19.2% of those with 10-30 beds.

Table 6: Presence of positive tests by care home number of Care Inspectorate registered beds (in quartiles)

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
10 to 30 registered beds N=26 care homes, 571 beds	6 (23.1)	15 (57.7)	5 (19.2)
31 to 40 registered beds N=24 care homes, 870 beds	1 (4.2)	9 (37.5)	14 (58.3)
42 to 60 registered beds N=26 care homes, 1430 beds	1 (3.8)	11 (42.3)	14 (53.8)
63 to 119 registered beds N=20 care homes, 1621 beds	0	3 (15.0)	17 (85.0)
No data N=14 care homes*	2 (14.3)	4 (28.6)	8 (57.1)

X^2=24.8, df=8, p=0.002 (small expected counts in many cells)

* Total of 703 registered places (which is similar but sometimes smaller than the number of beds).

Table 7: Presence of positive tests by care home number of WTE staff reported to Care Inspectorate (in quartiles)

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
5.5 to 24.1 WTE staff N=24	6 (24.0)	11 (44.0)	8 (32.0)
24.2 to 34.4 WTE staff N=24	1 (4.2)	14 (58.3)	9 (37.5)
35.0 to 57.6 WTE staff N=24	1 (4.2)	7 (29.2)	16 (66.7)
58.0 to 145 WTE staff N=23	1 (4.3)	4 (17.4)	18 (78.3)
No data N=14	1 (7.1)	6 (42.9)	7 (50.0)

X^2=20.8, df=8, p=0.008 (small expected counts in many cells)

There was no associations between testing or having a positive case by the local authority area/Integrated Joint Board that the care home was in, or by Care Inspectorate ratings of quality in four domains – (i) Support and care; (ii) Environment; (iii) Staffing; (iv) Leadership and management (tables below). The health board perspective on that was that care assurance standards don't cover the content, quality and professionalism of care very well, and that in particular there is little systematic training on care for the acutely unwell resident and infection control.

Further tables

Table 8: Presence of positive tests by Integrated Joint Board

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**

IJB1 N=66	8 (12.1)	19 (28.8)	39 (59.1)
IJB2 N=17	1 (5.9)	9 (52.9)	7 (41.2)
IJB3 N=16	0	9 (56.3)	7 (43.8)
IJB4 N=11	1 (9.1)	5 (45.5)	5 (45.5)

X^2=7.6, df=6, p=0.27 (small expected counts in many cells)

*Table 9: Presence of positive tests by Care Inspectorate rating of Quality of Care and Support**

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
Weak or adequate N=21	2 (9.5)	9 (42.9)	10 (47.6)
Good N=32	1 (3.1)	12 (37.5)	19 (59.4)
Very good or excellent N=41	5 (12.2)	15 (36.6)	21 (51.2)
No data N=16	2 (12.5)	6 (37.5)	8 (50.0)

X^2=2.5, df=6, p=0.87 (small expected counts in many cells)

* Original 6 point scale – 1 – inadequate, 2 weak, 3 adequate, 4 good, 5 very good, 6 excellent. No care home scores 1; 2 and 6 have small numbers so categories combined.

*Table 10: Presence of positive tests by Care Inspectorate rating of Quality of Environment**

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
Weak or adequate N=17	2 (11.8)	9 (52.9)	6 (35.3)
Good N=37	2 (5.4)	11 (29.7)	24 (64.9)
Very good or excellent N=40	4 (10.0)	16 (40.0)	20 (50.0)
No data N=16	2 (12.5)	6 (37.5)	8 (50.0)

X^2=4.7, df=6, p=0.58 (small expected counts in many cells)

* Original 6 point scale – 1 – inadequate, 2 weak, 3 adequate, 4 good, 5 very good, 6 excellent. No care home scores 1; 2 and 6 have small numbers so categories combined.

*Table 11: Presence of positive tests by Care Inspectorate rating of Quality of Staffing**

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
Weak or adequate N=16	2 (12.5)	6 (37.5)	8 (50.0)

Good N=33	2 (6.1)	13 (39.4)	18 (54.5)
Very good or excellent N=45	4 (8.9)	17 (37.8)	24 (53.3)
No data N=16	2 (12.5)	6 (37.5)	8 (50.0)

X^2=0.8, df=6, p=0.99 (small expected counts in many cells)

* Original 6 point scale – 1 – inadequate, 2 weak, 3 adequate, 4 good, 5 very good, 6 excellent. No care home scores 1; 2 and 6 have small numbers so categories combined.

*Table 12: Presence of positive tests by Care Inspectorate rating of Quality of Management and Leadership**

Care home characteristic N=110	**No testing** **No (%) of care homes**	**One or more tests, all negative** **No (%) of care homes**	**One or more positive tests** **No (%) of care homes**
Weak or adequate N=21	2 (9.5)	9 (42.9)	10 (47.6)
Good N=29	2 (6.9)	12 (41.4)	15 (51.7)
Very good or excellent N=44	4 (9.1)	15 (34.1)	25 (56.8)
No data N=16	2 (12.5)	6 (37.5)	8 (50.0)

X^2=1.0, df=6, p=0.98 (small expected counts in many cells)

* Original 6 point scale – 1 – inadequate, 2 weak, 3 adequate, 4 good, 5 very good, 6 excellent. No care home scores 1; 2 and 6 have small numbers so categories combined.